PolyMet Tailings Seepage Briefing (November 2015)

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How significant is seepage from the PolyMet tailings waste facility?

- PolyMet tailings would be deposited in a wet slurry on top of the existing unlined LTVSMC tailings piles. (FEIS 4-427, 5-5, 5-185) The LTVSMC tailings waste facility is approximately 4½ miles square. It is built above wetlands and three small streams. (See Figures 1, 2 and 3).

- PolyMet would produce 110,736 tons of wet tailings slurry per day, of which liquids would be 68.5 percent by weight or 86 percent by volume. (PolyMet 2015q, autop. 621)

- The PolyMet tailings waste facility would not be lined to contain seepage. (FEIS 3-104, 3-158) PolyMet sulfide mine tailings slurry would be deposited immediately above LTVSMC tailings and slimes. (Figure 4) There are fractures beneath the tailings site that could carry seepage through bedrock. (Figure 5)

- PolyMet tailings seepage would be collected from the toe of the tailings heaps and would contain sulfates and heavy metals from copper-nickel processing slurry, effluent from the mine site treatment plant, and LTVSMC tailings. (PolyMet 2015j, FEIS Fig. 3.2-12).

- The completed tailings height of the PolyMet waste cells would be 1,735 above sea level. (FEIS 3-104). That is 60 feet higher than the highest feature to the east and more than 200 feet higher than gradient on the west, northwest, north and south sides of the tailings. (See Figure 6). Elevations above surrounding land creates hydraulic pressure for seepage.

- Under current conditions, seepage upwells from the base of the tailings and from groundwater as well as permeating through groundwater. (FEIS 4-113). During operations, PolyMet predicts its total tailings seepage will increase to 3,880 gallons per minute. (FEIS 5-179, 5-181). This is equivalent to 2,041,000,000 gallons of contaminated seepage per year.[1]

What is claimed regarding the efficacy of PolyMet's capture of contaminated seepage from its proposed unlined tailings waste facility?

- PolyMet claims that 3,860 gpm of the total 3,880 gpm of tailings seepage during its operations would be collected. (FEIS 5-181, PolyMet 2015j). This would be an improbable nearly perfect capture efficiency of 99.5%.

- On the _east_ side of the tailings waste facility, the PFEIS states that seepage containment "would be expected to capture 100 percent of tailings surface seepage and groundwater seepage." (FEIS 5-8).[2]

- On the _south_ side of the Tailings Basin, the PFEIS claims "an existing seepage containment system would be upgraded by PolyMet to achieve 100 percent capture of tailings surface and

[1] Conversion site at http://www.convert-me.com/en/convert/flow_rate_volume/gallon_day.html
[2] There is no modeling in any PolyMet documents of *any* seepage on the east or south side of the tailings facility.

groundwater seepage that otherwise would flow into Second Creek, a tributary of the Partridge River." (FEIS 5-102).

- No *range* of collection performance is considered in the PolyMet PFEIS to assess adverse impacts on water quality; nearly perfect containment of tailings seepage "is assumed for purposes of impact evaluation":
  - 100 percent of the Tailings Basin's surface seepage;
  - 100 percent of the groundwater approaching the containment system from the Tailings Basin's east and south toes; and
  - 90 percent of the groundwater approaching the containment systems from the Tailings Basin's north, northwest and west toes. (FEIS 5-186)

- "The design basis for the containment system is . . to reverse the pre-existing hydraulic gradient (and flow direction) across the facility." (FEIS Appx. A-547)

What is the claim of near perfect PolyMet tailings seepage collection based on?

- Overall, claims of capture efficiency are based on PolyMet's assumptions and models:

  "The capture efficiencies in water quality modeling were provided by the PolyMet (Barr 2015e, as cited in the FEIS)."[3] (FEIS Appx. A-583)

  "[T]he assumed capture efficiencies of the groundwater containment systems are justified and supported by modeling." (FEIS Appx. A-578, A-612)

  "Performance modeling of the north and northwest flowpaths has indicated that the proposed systems would provide greater than 90 percent capture of surficial aquifer and bedrock groundwater to 100 ft below the top of bedrock. Containment systems are assumed to capture 100 percent of tailings surface seepage." (FEIS 5-77)

- On the <u>*south*</u> side, claims of 100 percent tailings seepage collection are based on a promise:

  A collection system on the south side (SD026) of the tailings heaps installed by Cliffs Erie in 2011 included a cutoff berm and trench, seep collection sump, pump and pipe system. (PolyMet 2015i). However, "It is acknowledged that there is currently incomplete capture of impacted water at SD026." (FEIS Appx. A-625). Water is bypassing the cutoff dam, and improvements in collection would be required to comply with the Cliffs consent decree.[4]

  PolyMet's claims for 100 percent seepage capture on the *south* side are based on a vague promise that unspecified future upgrades will achieve perfect collection: "PolyMet has committed to future upgrades to achieve 100 percent capture by this system if the NorthMet Project Proposed Action is approved." (*see e.g.* FEIS A-84, A-195, A-197, A-616, 3-120)

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[3] Replaces PFEIS text, ""The assumed capture efficiencies in water quality modeling were provided by the Proponent in memorandum that is referenced in the FEIS."

[4] Barr, Water Balance Evaluation of SD026 Seepage Collection System and Cell 1E Pond Water Levels (May 1, 2013); MPCA (John Thomas) letter to Cliffs Natural Resources (Craig Hartmann), April 4, 2013.

Does field experience support PolyMet's capture efficiency claims?

- The Co-Lead agencies acknowledge, "Relatively few capture systems have been built with this degree of pumping to cause a reversal of the pre-existing hydraulic gradients." (FEIS Appx. A-548). Research has disclosed no systems operating long-term to reverse hydraulic gradient.

- A 2012 Barr memo (Attachment D to PolyMet 2015h) cites several examples of allegedly successful containment facilities. None of these facilities achieve the capture efficiencies claimed for the PolyMet tailings facility.

- Barr emphasizes the success of mine tailings seepage containment in Alberta, Canada. But, this technology is failing, with serious consequences:

  Barr cites the Fort McMurray tailings pond as an example of success: "Another example is the installation of a soil-bentonite cutoff wall around the perimeter of a mine tailings pond located in the province of Alberta, Canada. The cutoff wall is approximately 100-feet deep and 3 feet wide, and has a hydraulic conductivity of less than 1×10^{-7} cm/sec. The cutoff wall was used to isolate the tailings pond from downgradient surface water features including wetlands and the Athabasca River." (PolyMet 2015h, Attachment D, pp. 1-2, Large Table 1)

  However, new Canadian federal research using chemical profiling to confirm the contaminant source in the Athabasca River has confirmed that toxic chemicals from Alberta's oil sand tailings ponds are leaching into groundwater and seeping into the Athabasca River, despite ditches, cutoff walls, groundwater interception wells and a system where captured water is pumped back into tailings ponds.[5]

  One dam has been reported to seep wastewater at a rate of 75 liters per second (625,200,000 U.S. gallons per year) into groundwater feeding the Athabasca River.[6] Industry is working to address the tailings issue, budgeting more than $1-billion in tailings-reduction technology.[7]

- Data on capture of seepage from unlined waste facilities does not support PolyMet's modeling assumptions. In Minnesota, MPCA concluded in 2008 that the maximum estimated percentage of seepage to the Sandy River that could be collected from the unlined Minntac tailings waste facility was approximately 55 percent to 60 percent.[8] In 2013, U.S. Steel

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[5] Frank et al., *Profiling Oil Sands Mixtures from Industrial Developments and Natural Groundwaters for Source Identification*, Env. Sci & Tech. accepted Jan. 21, 2014. Available at http://www.thetyee.ca/Documents/2014/02/21/Profiling-Oil-Sands-Mixtures.pdf; Bob Weber, *Federal study says oil sands toxins are leaching into groundwater, Athabasca River*, Edmonton Globe and Mail, Feb. 20, 2014. Available at http://www.theglobeandmail.com/news/national/federal-study-says-oil-sands-toxins-are-leaching-into-groundwater-athabasca-river/article17016054/

[6] Andrew Nikiforuk, *Large dams of mining waste leaking into Athabasca River study*, Feb. 21, 2014, http://thetyee.ca/Blogs/TheHook/2014/02/21/Tailings-Waste-Athabasca/

[7] Weber, *supra* note 4.

[8] MPCA (John Thomas) letter to Tom Moe (U.S. Steel Corporation) of Jan. 10, 2008, available at http://waterlegacy.org/sites/default/files/PolyMet_SuppEIS/WL_Ex19_MPCA_MinntacSeepLtr_2008.pdf

confirmed that the dike and pump back system on the east side of the Minntac facility was collecting roughly 50 percent of the total seepage volume.[9]

- The highest rate of seepage capture identified for an engineered system appears to have been at the Hill Air Force Base in a northern Utah, where a combination of slurry walls, landfill covers, groundwater interception and extraction wells, and treatment succeeded in reducing metals concentrations by 80 percent.[10]

What analysis has been done to evaluate the effects on water quality and human health if less than 99.5% of the tailings seepage is collected in practice?

- The NorthMet Plant Site Water Modeling Plan states that "performance of engineered systems" is an "uncertain input," for which a probabilistic distribution should be defined. (Barr 2012d, pp. 1-2). Tailings collection slurry walls, trenches, berms and pumps are engineered systems.

- The PolyMet record contains no modeling of impacts for any range of capture inputs, despite the recognized uncertainty of collection system performance. Duluth doctors have requested modeling for a range of capture rates reflecting field experience to evaluate health risks.

- In the Agency's Pebble Mine assessment, the EPA recently concluded, "Water collection and treatment failures are a common feature of mines."[11] EPA stated that the probability of potential *failure* of water collection and treatment during operations is 93 percent, and results include "exceedance of standards potentially including death of fish and invertebrates." Post-closure probability of failure of water collection and treatment was "somewhat higher than operation," and "failures are likely to result in release of untreated or incompletely treated leachates for days or months. If the site were to be abandoned, EPA noted that failure of water collection and treatment was "certain." [12]

Why is the assumption of perfect or near-perfect tailings seepage collection significant?

- Unrealistic assumptions of seepage escape undermine analysis of critical tailings seepage mitigation strategies that cannot be implemented after-the-fact, such as liners and dry filtered tailings disposal.

- Decision-makers cannot accurately evaluate probable impacts of PolyMet tailings waste seepage on compliance with numeric and narrative water quality standards, aquatic life, wild rice and human health.

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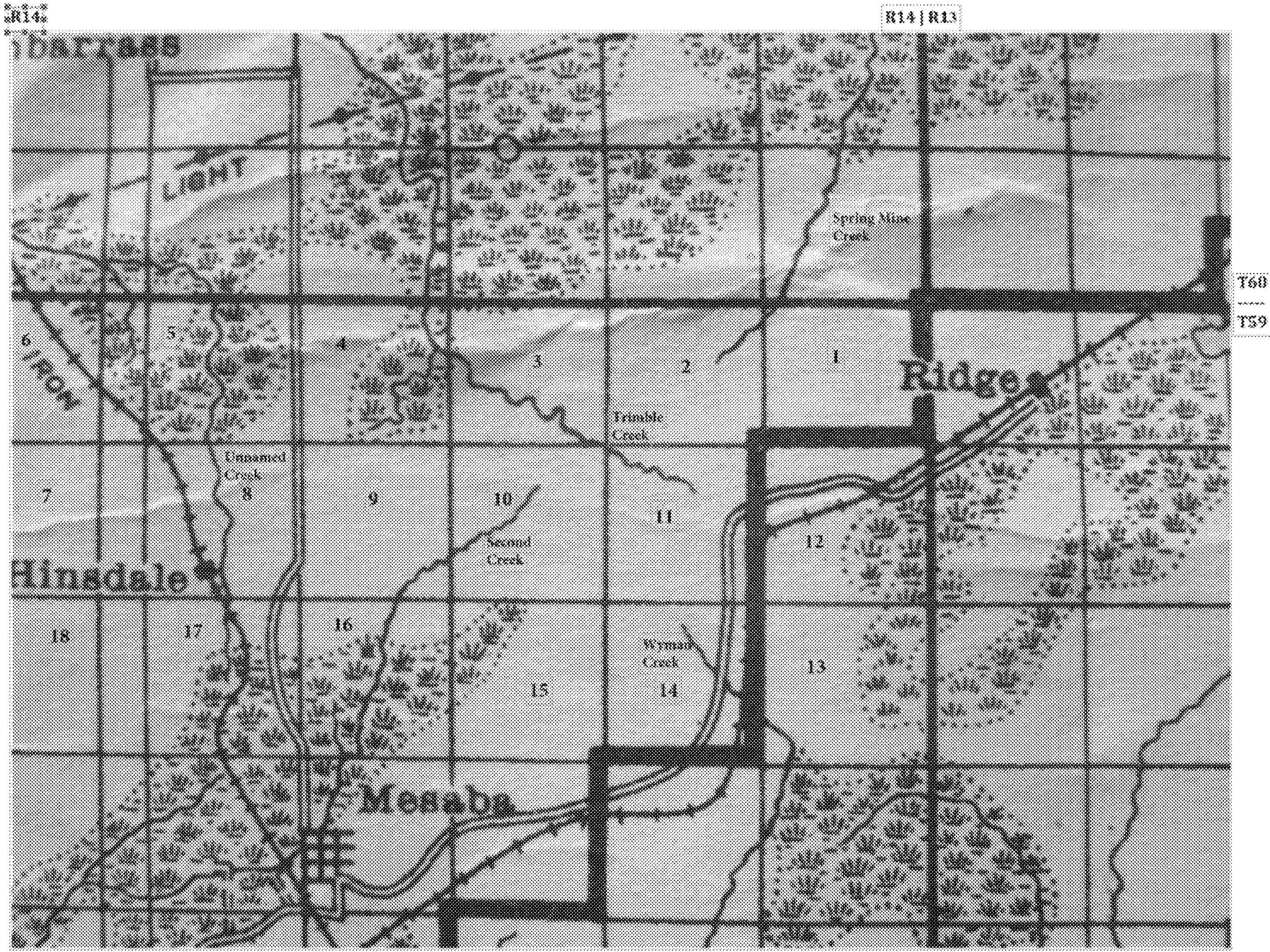
[9] U.S. Steel (Chrissy Bartovich) letter to U.S. Army Corps of Engineers, July 9, 2013, letter with attachment excerpt available at http://waterlegacy.org/sites/default/files/PolyMet_SuppEIS/WL_Ex20_U.S.Steel_MinntacLtr_2013.pdf
[10] EPA, *Engineering Bulletin Slurry Walls* (October 1992), p. 5, available at http://nepis.epa.gov/Exe/ZyPDF.cgi/10002DPY.PDF?Dockey=10002DPY.PDF
[11] EPA, *An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska*, Volume 1 – Main Report (EPA 910-R-14-001A (January 2014), p. 8-19, available at http://www2.epa.gov/sites/production/files/2015-05/documents/bristol_bay_assessment_final_2014_vol1.pdf
[12] *Id.*, Table ES-4 and Table 14-1

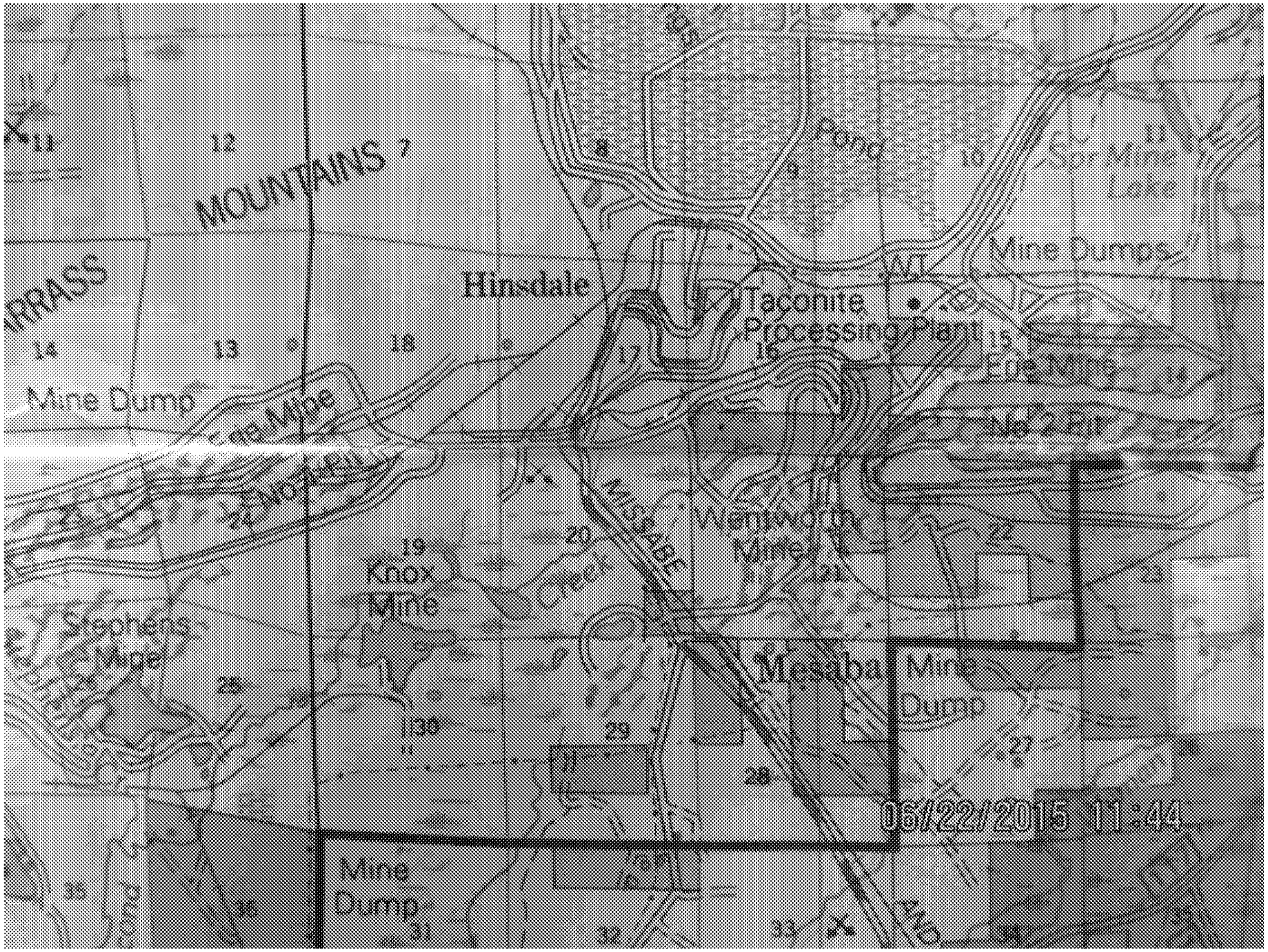
Figure 1. Area of LTVSMC Tailings Facility, U.S.F.S. Superior National Forest Map, 1938.



This map shows township, range and section notations along with creek names. The LTVSMC tailings basin will be located in the map sections identified as 3, 4, 5, 8, 9, and 10.

The origin of Second Creek lies under the LTVSMC southern tailing basin facility in section 10 and under mine waste rock piles in and near section 16. Second Creek flows south and southwest to the Partridge River. Trimble Creek runs beneath the tailings basin in section 3 in the northeast quarter of the tailing basin and flows northwest to the Embarrass River. An unnamed creek emerges from under the northwest corner of the tailing basin in approximately section 5 of Figure 5a and flows generally west to Embarrass River.

Figure 2, LTVSMC Tailings Facility and Second Creek Features, U.S.F.S. Map 1997, revised 2011.



By 1997, in addition to headwaters for Second Creek, the LTVSMC tailings waste facility will inundate Trimble Creek and Unnamed Creek. This area is shown as "Mine Dumps" in sections 10 and 11 of the map.

This map also reflects 1997 conditions, including the relationship of Second Creek to wetlands and other mine features. As of 1997, the northeast quadrant of what will become the LTVSMC tailing basin north of the Taconite Processing Plant still shows Trimble Creek headwaters. This area will later be inundated with tailings.

Figure 3, Map of Existing LTVSMC and Proposed PolyMet Tailings Locations (Large Figure 1, PolyMet 2015i)

This Figure shows the existing tailings site, the proposed project area, the current SD026 pumpback site and stormwater flow. PolyMet tailings would be placed on top of LTVSMC tailings in Cell 1E and Cell 2E.

Figure 4, PolyMet Proposed Tailings Deposition Cross-Section (FEIS, 2015)

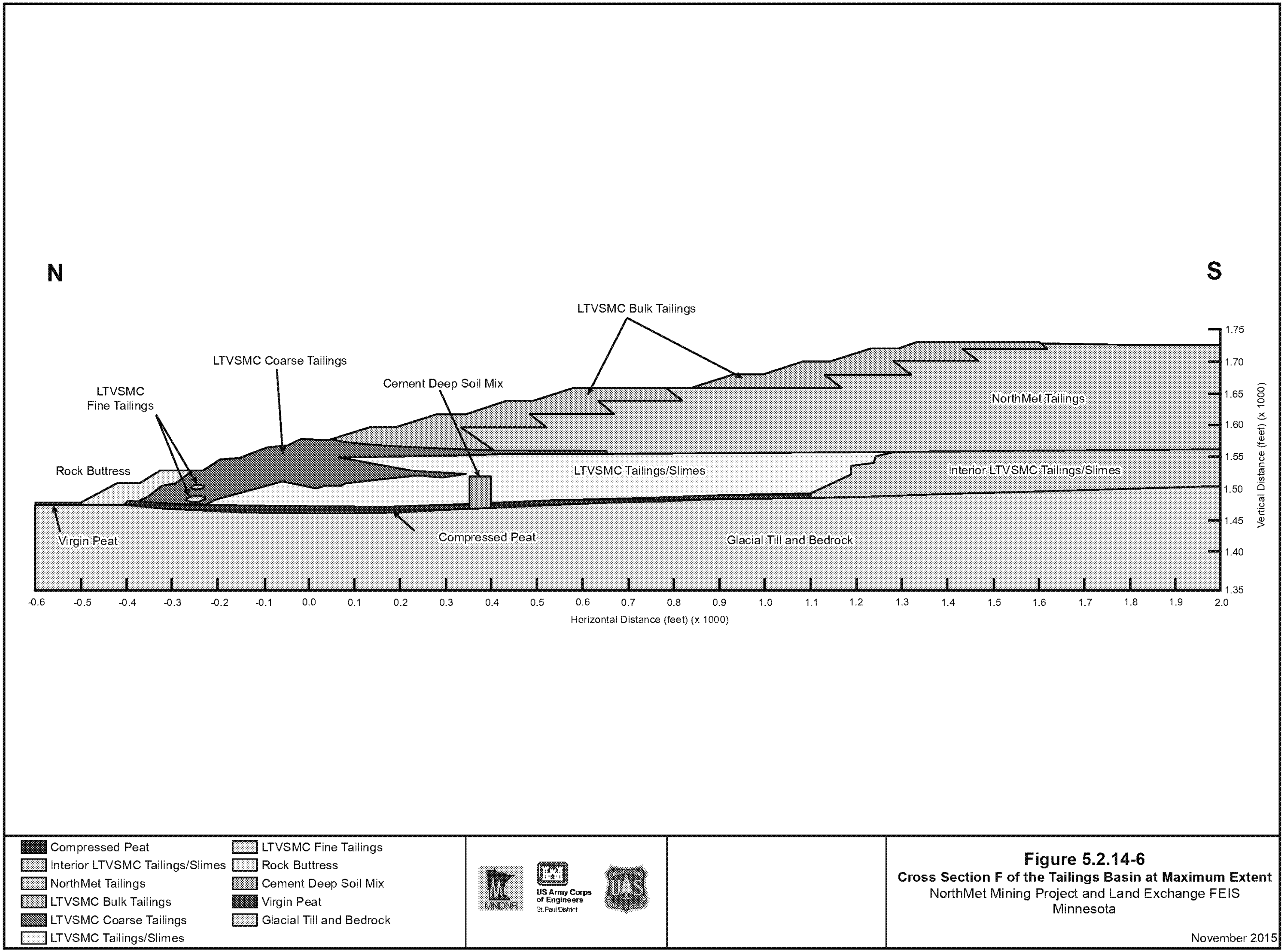
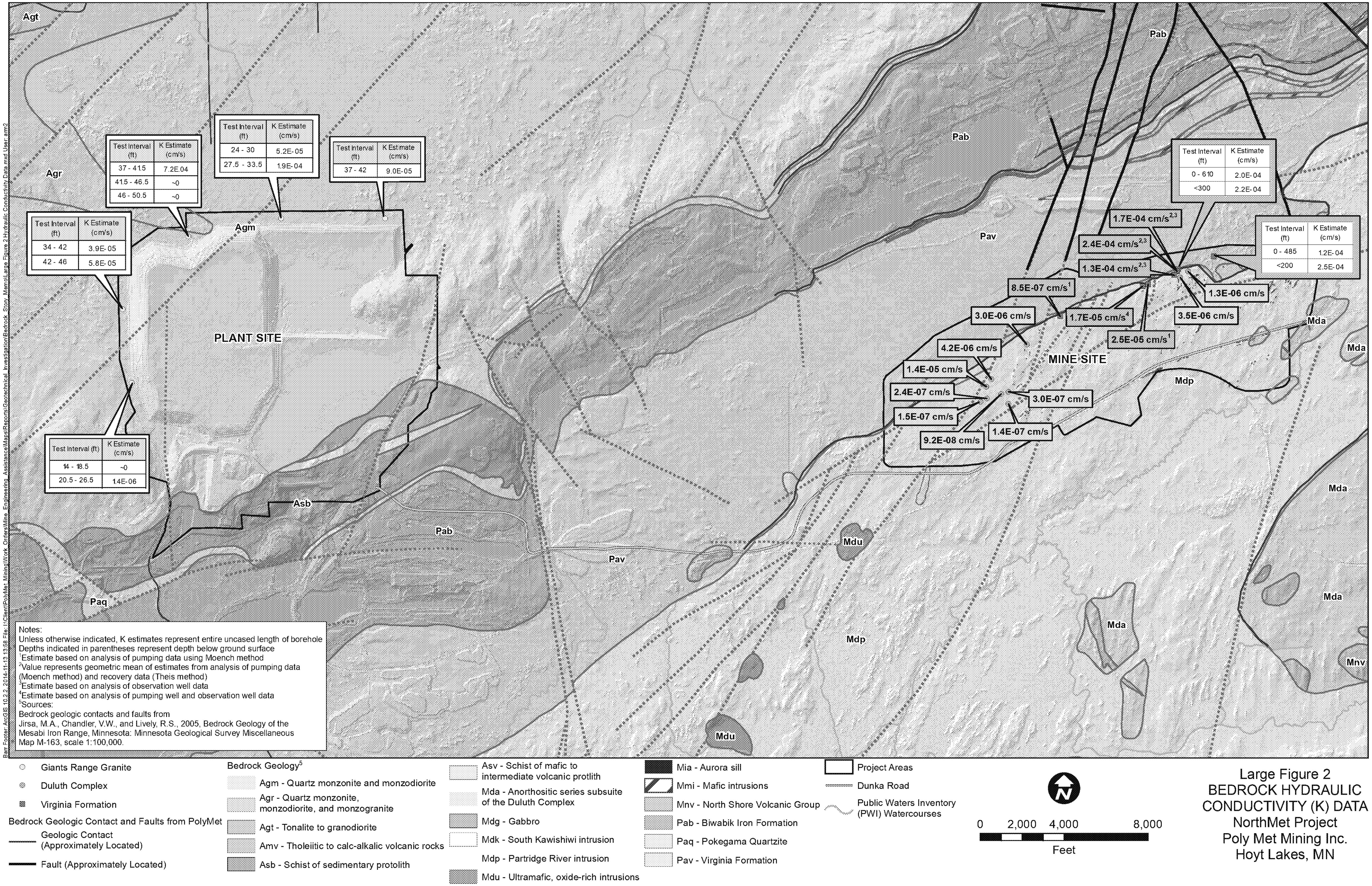


Figure 5.2.14-6
Cross Section F of the Tailings Basin at Maximum Extent
NorthMet Mining Project and Land Exchange FEIS
Minnesota

November 2015

Figure 5, Fractures and Bedrock Geology beneath the PolyMet Tailings and Mine Sites (Barr 2014b)



Large Figure 2
BEDROCK HYDRAULIC CONDUCTIVITY (K) DATA
NorthMet Project
Poly Met Mining Inc.
Hoyt Lakes, MN

Figure 6, Tailings Site Groundwater Elevations (FEIS, 2015)